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IMAGING VIGNETTE

Real-Time 3D TEE Allows Optimized Guidance of Percutaneous Edge-to-Edge Repair of the Mitral Valve

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PERCUTANEOUS MITRAL VALVE REPAIR USING the edge-to-edge technique has been shown to be safe and effective for treatment of mitral regurgitation considering specific indications (1). Two-dimensional (2D) transesophageal echocardiography (TEE) has been described for guidance of the procedure (2,3). The complex spatial structure of the mitral valve, as well as the complex interaction of the interventional device with parts of the beating heart, requires optimal real-time (RT) spatial visualization. RT 3-dimensional (3D) TEE allows the acquisition of pyramidal datasets which can be used to visualize the size, shape, and motion of cardiac structures from multiple perspectives.

The following 2D TEE and RT 3D TEE images demonstrate the superior guidance of percutaneous edge-to-edge mitral valve repair using RT 3D TEE. In a series of 26 patients, RT 3D TEE provided important additional imaging information compared to 2D TEE in several critical steps of the procedure. In particular, safe guidance of the clip delivery system through the left atrium towards the mitral valve (Fig. 1), precise positioning of the clip delivery system in the middle of the intercommissural line as well as at the center of the regurgitant jet (Fig. 2), accurate alignment of the clip arms perpendicular to the intercommissural line in the left atrium as well as the left ventricle (Fig. 3), confirmation of correct grasping location in the middle of anterior and posterior mitral leaflet resulting in a symmetric split of the mitral orifice (Fig. 4), and adequate positioning of a second clip relative to the first clip if required by remaining mitral regurgitation (Fig. 5) were strongly supported with RT 3D TEE. While 2D TEE required several views to determine the precise clip position with the need to change also the transducer position, RT 3D TEE provided even more information within one transducer position.

In the complex interventional edge-to-edge repair with the MitraClip device (Abbott Vascular Structural Heart, Menlo Park, California) requiring optimal spatial information RT 3D TEE allowed improved guidance of the procedure. RT 3D TEE guidance resulted in great operator confidence to adequately perform the procedure. It is likely to reduce time requirements to perform individual procedural steps, and increase safety in the performance of procedural steps.

From the Medical Clinic I, University RWTH Aachen. The authors have reported that they have no relationships to disclose.

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Figure 1. Advancement of the Clip Delivery System Through the Left Atrium After Transseptal Puncture

Real-time 3-dimensional transesophageal echocardiography in zoom mode providing an overview of the left atrium in an altered surgical view. Real-time imaging helps to prevent contact of the clip delivery system with the left atrial wall during the complex steering and advancement procedure towards the mitral valve. CDS = clip delivery system; IAS = interatrial septum.

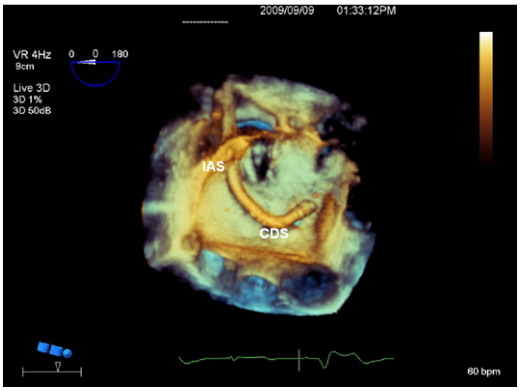


Figure 2. Positioning of the Clip Delivery System Above the Mitral Valve

(A) 2D TEE left ventricular outflow tract view demonstrating adequate clip position in anterior-posterior direction, **(B)** 2D TEE with intercommissural view demonstrating adequate clip position in medial-lateral direction. **(C)** RT 3D TEE with 3D zoom mode demonstrating nonoptimal, too lateral position of the clip delivery system. Considerations on the required movements are facilitated with the spatial overview of the 3D zoom mode. Movement of the clip delivery system to the required position is possible by external adjustment in medial-lateral and anterior-posterior direction using the steering mechanism. **(D)** RT 3D TEE demonstrating optimal position of the clip in anterior-posterior as well as medial-lateral direction after performing the necessary adjustments **(A and B).** AL = anterolateral; PM = posteromedial; RT = real-time; TEE = transesophageal; 3D = 3-dimensional; 2D = 2-dimensional.

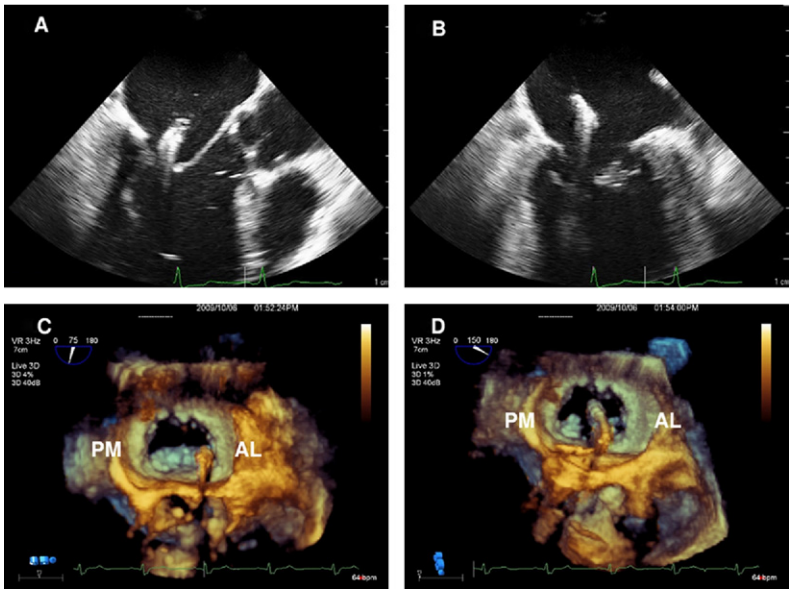


Figure 3. Adjustment of Opened Clip Arms Perpendicular to the Commissural Line Before Advancement Through the Mitral Valve

(A) 2D TEE left ventricular outflow tract image. Similar length of clip arms indicate adequate adjustment of open clip arms perpendicular to the commissural line, **(B)** RT 3D TEE with zoom mode demonstrating non-optimal perpendicularity to the commissural line in spite of adequate adjustment of the opened clip arms in 2D TEE, **(C)** RT 3D TEE image of opened clip showing adequate perpendicularity to the commissural line after adjustment of the clip arms using RT 3D TEE. AV = aortic valve; other abbreviations as in Figure 2.

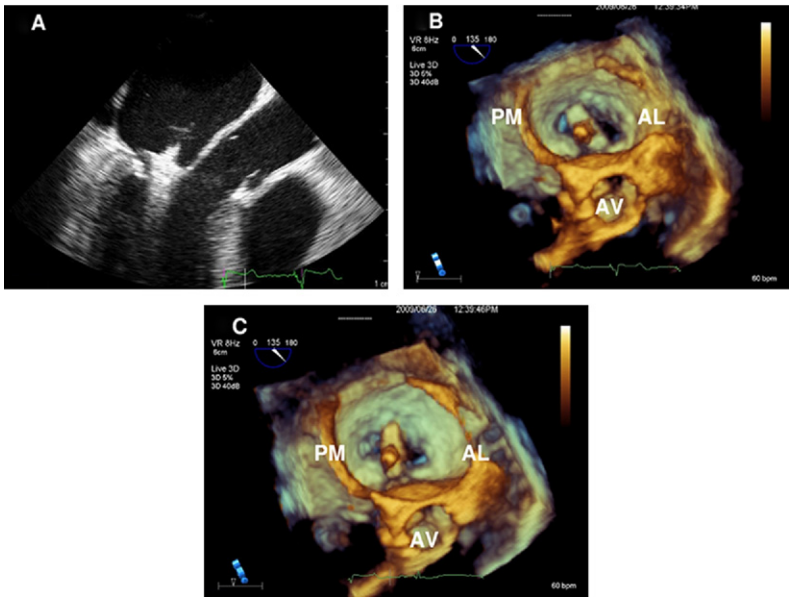


Figure 4. Visualization of the Resulting Orifices of the Mitral Valve After Closing the Clip

RT 3D TEE image acquired in zoom mode with the clip placed at the central point of the commissural line of the mitral valve. The leaflets are hold together with 2 resulting orifices of approximately similar size medial and lateral to the clip. The clip is still fixed to the delivery system. Abbreviations as in Figures 2 and 3.

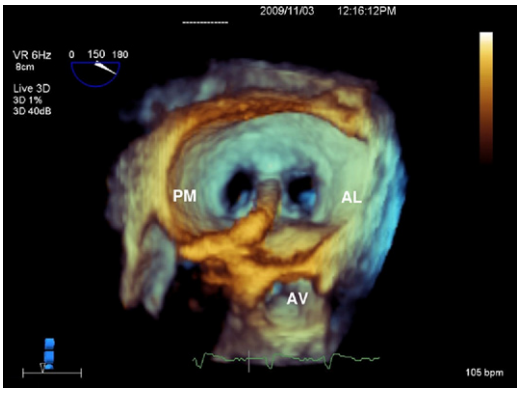
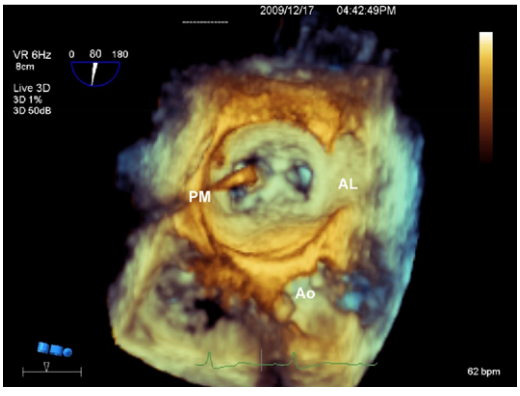


Figure 5. Positioning of a Second Clip

RT 3D TEE image acquired in zoom mode of a patient with placement of two clips. One clip is already placed. The second clip is advanced towards the larger of the two orifices where color Doppler echocardiography has demonstrated remaining mitral regurgitation (medial to first clip). Ao = ascending aorta; other abbreviations as in Figure 2.



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